AN

INAUGURAL LECTURE

ON

BOTANY,

CONSIDERED AS A SCIENCE, AND AS A BRANCH OF MEDICAL EDUCATION.

READ IN KING'S COLLEGE, LONDON, MAY 8th, 1843.

BY

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Mr. Principal and Gentlemen,

One of the last friends from whom I parted before leaving England two years ago on a voyage of research in the East, was the distinguished and much-lamented botanist whom I have the high but melancholy honour of succeeding in this chair. His last words on that occasion were instructions for my guidance during a proposed investigation of the natural history of the Archipelago and Asia Minor. The great knowledge which he possessed of botanical science was freely and enthusiastically imparted to all who had the pleasure and benefit of his acquaintance. In the place of that knowledge and experience, I fear I can only offer a fervent attachment to his favourite pursuit, and a determination energetically to labour in the service of this noble Institution.

The duties of the Botanical Professorship are, the teaching of Botany as a science, and as a branch of medical education. Being rather an ally than a province of medicine, it forms a connecting link between professional and purely scientific studies. The nature of the subjects of which it treats, requires that it should be numbered among the studies of the Summer Session, when it is honourably associated in the medical department with forensic medicine and practical chemistry. In this introductory lecture I propose, with your permission, to offer a few remarks on the Natural-History sciences generally, and on Botany in particular, as branches of medical education; to take a brief view of the relations of Botany to other pursuits; and to offer some considerations upon the science, and upon the principles of acquiring a knowledge of it.

The Natural-History sciences are three:—Zoology treating of the animal kingdom, Botany of the vegetable, and Mineralogy of the inorganic bodies abounding in nature.

These three are united by the inquiries of GEOLOGY, which is rather an exposition of their mutual connexion than a separate science of itself. It may be looked upon as the history of the earth's changes during its preparation for the reception of organized beings, and of the causes which determined the order of their appearance—the proemium of the history of MAN.

The biological sciences, zoology and botany, are intimately related to physiology and anatomy; and the more those sciences advance, the closer will be the connexion. In the most remote divisions of the animal and vegetable kingdoms, we find the keys which enable us to lay open and understand the mysteries of vital phænomena. Through a knowledge of the structure of a simple polype we may comprehend more clearly the complicated machinery of the body of man; and the observation of the origin and development of a seed may throw light upon one of the most intricate functions in the animal economy.

The views of systematic botany and of systematic zoology are fast attaining a parallelism which must end in the discovery and development of great general laws common to both. The two great kingdoms of organized nature seem to spring, as it were, from one root, and to branch out into correspondent trunks, which, even at their most distant ramifications, exhibit mutual analogies. The lowest forms of each so closely approximate as to furnish subjects for continual discussion; and the number of species, the position of which, whether in the animal or vegetable kingdom, is as yet disputed or undetermined, proves the close alliance of the animal and vegetable natures toward the point of union. Creatures which Ehrenberg figures as animalcules, Meyen describes as plants; and naturalists have not yet ceased debating on the nature of sponges and corallinæ. As we ascend in each great

series, the animal or vegetable nature of their respective members becomes more and more decided and unquestionable, while there is still retained a close resemblance of external form. Thus a *Mucor*, an *Agaricus* and a *Sphæria* image, as it were, their parallels and yet opposites, a *Hydra*, a *Medusa* and an *Echinus*. Ascending higher we find all resemblance of form disappear, but still there is a true analogy. The exoskeleton of the *Monocotyledones* represents, though far and faintly, the exoskeleton of the *Articulata*; and the endoskeleton of the *Dicotyledones* the same great modification of structure in the *Vertebrata*. Both kingdoms seem pervaded by a double representation of each other,—two great spheres, as it were, repeated within themselves; a representation which will in all probability be found as true in the minor as in the major groups of organized beings.

Very different laws regulate the mineral kingdom. Life absent, all the wonderful structures which result from its formative presence have disappeared. Aggregation is but a faint remembrancer of assimilation, and crystallization of organization. The laws of chemistry take the place of the laws of physiology, and it is in the laboratory that a great and important portion of the observations of the mineralogist must be conducted. Those who would gain a sound knowledge of the inorganic substances found in nature, should avail themselves of the instructions and exercises of the practical chemistry class-room as a preliminary study of essential importance; one too of no small consequence to the biologist, as well as absolutely necessary to the physician.

In all the natural-history sciences the process of inquiry is the same. A close and patient investigation of structure is entered into, and a careful examination and comparison of forms with a view to the grouping of them in natural assemblages, the right understanding of which exposes to us the

great laws from the operation of which the admirable harmony pervading nature and manifesting creative wisdom results. Much, very much, yet remains to be done; and there is no fresher field for original research, and the development of a grand philosophy, than that of natural history.

Of all the natural-history sciences BOTANY is the most advanced and the most pursued. From an early period in man's history the attention of the observing had been directed towards the vegetable kingdom, partly from the facilities for the study of plants—assembled as they are in their various kinds abundantly around us—and partly on account of their virtues, real or imaginary. In the olden time the herborist and the physician were one: in nations as yet unemerged from their infant or barbarous state they are one still. The objects of the study were at first purely utilitarian. Fanciful resemblances to the forms or symptoms of disease furnished the principles of botanical arrangement. But continued inquiry, even when conducted upon false principles, led at length from empiricism to science, and the herborist ripened into the botanist. A new light broke upon him. Plants were no longer to be regarded as mere depositaries of decoctions and elixirs, but were to be examined for their own sakes. The wonders of their structure were exposed; the variety of their forms compared and classified. Their lives were written. The vital processes, continually going on within their bodies, were explored; their affinities with each other and with the animal kingdom investigated; and their history became a store, from whence could be drawn at pleasure numberless admirable examples of the perfection of design in creation, and of the benevolence and omniscience of the Creator.

This change in the object and manner of the studies of the botanist did not, however, divorce the science from its union with medicine. On the contrary, it bound their ties firmer

together. The true knowledge gained by studying the vegetable kingdom scientifically yielded more benefit to medicine than all the fancies and dreamy theories of the herborist. We learned that the properties of plants were correspondent to their natural affinities; and the discovery of the botanical relations of a species gave us the true clue to its useful qualities. Reason banished fancy from the selection of vegetable remedies, and the gain to medical science was great indeed.

The teaching of Botany in its relations to Medicine is not one of the least important duties of this chair. But I should be deceiving my pupils and myself if I encouraged for a moment the supposition that such object is to be gained by the mingling of herboristic notions with the more scientific parts of the subject. That the medical student acquires but little by his attendance at botanical lectures, is not an uncommon fancy among the senior members of the profession. Some eminent men have gone so far as to denounce it as lost time. The utmost the student is supposed to carry away is a knowledge of the names, classes and orders of such plants as furnish products used in medicine. It seems to me that the true object of the connexion of natural-history studies with more professional pursuits is, as in this case, too generally lost sight of, and I gladly avail myself of this opportunity to urge their claims on your attention, and to plead for them on grounds which have not been put forward sufficiently prominently hitherto, though by no means novel, seeing that the positions I am about to maintain are avowedly acknowledged in private by most scientific teachers, though rarely advanced in the class-room. The plea which I wish to advance is, that the main use of the natural-history sciences to the student is not merely the teaching him a certain number of facts, the recollection of which may be serviceable to him in after life, but the training his mind, by means of the peculiar forms of

research which characterise those sciences, to that tone and vigour which must be of the utmost consequence in giving him power for future professional avocations of a different nature, especially such as are to form the after-occupations of the student of medicine.

Not that for a moment I would have you suppose that I am depreciating the value of a knowledge of the facts of natural history,—far from it: I have myself derived too much pleasure, too much benefit from an early study of that delightful science not to appreciate its full value, and not to be desirous of seeing all men acquainted with it; but that, viewing it as a branch of education, I am anxious to point out in what its true educational value lies, and not to evade the question by enumerating how many animals, plants and minerals a student may be able to recognise if he diligently pursue zoology, botany, or mineralogy. A student of any science, well-trained in the modes of investigation which that science teaches, is a much more valuable member of society than a youthful encyclopedia or a living book of facts.

The two qualities most essential to the physician are *correct observation* and *accurate discrimination*. The first depends mainly on the power of seizing all the features of an object or case with clearness and facility, detecting adventitious characters at sight, and excluding such from all influence on our conclusions. The second implies powers of just comparison, of perceiving the mutual relations of parts or facts, and of testing the possible agreement of statements with the circumstances which accompany them. Now though all men are endowed with the elements of these qualities, all are not born correct observers or accurate discriminators. Men must be educated into such. The mind must be trained to reason justly, the instruments of the mind to observe correctly. The classical and mathematical studies of our youth are not in-

tended merely to teach classics and mathematics, but to train us to the business of life, and to right judgement in the higher pursuits of men. The bodily exercises of our youth have not for their object merely those pleasures which such exercises afford, but the strengthening of our physical powers in order to ensure us a healthy and vigorous manhood. The training of the mind makes the intellectual man, the training of the body the physical man. The end is gained in both cases by means essentially distinct from that end. Now I hold that natural history should be regarded in a similar light among the studies of the young physician.

The first lesson of natural history is observation. The study of an animal or vegetable species is the perfection of observation as far as that species is concerned. The form, the substance, the qualities, the phænomena of existence, the influence of surrounding objects, are all observed with the greatest precision, and defined so as to be capable of expression in words. No point affecting that species is left untouched. The study of a group or genus of animals or vegetables is in like manner the perfection of discrimination. All the members of the group are compared in all their parts with each other, the relations which they have in common are summed up, and their differences recorded in every possible point of view. The causes of those relations and differences are anxiously inquired into, and a survey is taken of the bearings of the whole group to its proximate allies, and, finally, to all equivalent assemblages in organized nature.

Who can rise up from such a study and not feel mentally strengthened? The mind through such an exercise must gain in both its analytic and synthetic powers. Such an investigation calls into action all the faculties, the perfectionizing of which is essential to the formation of a sound physician. The mental process is the same at the bed-side of the patient

and in the cabinet of the naturalist: its first element, correct observation, leading to correct diagnosis; the second, accurate discrimination, leading to sound methods of treatment in the one case and philosophical views of affinity in the other.

It may be objected, that the student had much better learn all this at the bed-side than among fields and flowers. To this I would answer, that no training is so strengthening as that which separates the process from the object of the process. I believe the confounding of the two has been a great evil in medical education. It leads to habits of loose reasoning, and blunts the most valuable power of detecting fallacies. Too many professional works notoriously abound in bad logic resulting from such confusion. May we not remedy this defect by making the scientific branches of medical study—the collateral sciences as they are termed—means of educating the mind of the student, so as to enable him to enter on his practice with a truer eye and sounder judgement? It is well known that medical men who have had the benefit of a good scholastic education previous to the commencement of their professional studies enter upon the latter doubly armed, and throughout life often maintain their superiority over their brethren equal or even superior in natural talent, though wanting the benefit of such training. May we not remedy the defect in the case of the latter, and specialize the superiority of the former by means of the mental exercise afforded by the study of natural history? I do not mean that men should be made naturalists before entering on their medical studies, but that the practical and more abstract branches of the medical curriculum should be pursued equally together, and that, while the acquiring of professional information is a grand object of the student's pursuits, the training which gives the power to apply that information with precision be not lost sight of, but occupy a prominent place in the division of his time.

And here I would say a word or two on the propriety of the physician and surgeon combining scientific with professional knowledge. A time was when an acquaintance with the purely practical parts of their profession was all too many medical practitioners thought it necessary to acquire. This degrading idea was favoured by the non-professional public, and to gain a prominent position in literature or science was too often to close the gates of professional success. But that time is either gone by or is fast waning away. That profession, the investigations of which involve some of the deepest problems in human philosophy, must become more and more scientific every day. Sound education in literature and scientific instruction in his profession are fast elevating the character of the medical student; and, in the end, an unscientific practitioner will become as rare as a medical sceptic. One great evil which has tended to retard the intellectual advancement of the medical student, especially in this great city, has been the separation of his studies from all association with the pursuits of the scholar and the philosopher. The air of a hospital is mentally unwholesome, unless mingled with a full proportion of collegiate atmosphere. The very neighbourhood of literary and scientific studies has a purifying and elevating effect on the mind of the student.

In eastern cities men are grouped into castes, each confined to one occupation and inhabiting one quarter. Civilization is thereby impeded: men's minds become narrowed into mechanical modes of thinking, and, in the end, the whole nation suffers. Is there not something of the same kind in exclusive professional education?—a contraction of the mind, from its association during the most active and impressible phase of its earthly existence with such minds only as are absorbed in similar pursuits? Shut out from the spirit of letters, of science and of art, exclusively occupied with one set of thoughts

and practices, the man sinks into the drudge. But when the student finds he is marching onwards to the goal of knowledge along with a numerous company of youthful seekers after truth in all its varied forms, marshalled by skilful and earnest leaders, whose discipline alike regards their morals and their intellect, his mind warms in its sympathies, and extends its appreciation beyond its own special duties to a participation in those of its companions. Such a progress may be looked for as the result of the system followed in this Institution; and the young physician and surgeon who have been educated within its halls will have the high gratification of entering on the duties of life a scholar, a man of science, and a man of taste; and, above all, imbued with sound principles of religion and morality.

What I have said in regard to the importance of the natural-history sciences, more especially botany, the most advanced, as training studies, is not merely applicable to the medical profession, but also to all other pursuits, whether general or professional. Professor Daubeny, in the excellent essay which he has just published on the writings and philosophical character of the great botanist of Geneva, DeCandolle, whose recent death has been so severely felt by the scientific world, well remarks on his science, that, "if prosecuted in a philosophical spirit and with a constant reference to first principles, it might be capable of serving an important purpose in training and disciplining the mind of the student."

Though it seems to me that the greatest benefit his botanical studies confer on the medical student is the making him a correct observer and careful reasoner, there is a fact-knowledge which he can derive from them of the greatest consequence in his profession. There are more than 300 species of plants which furnish substances used as articles of Materia Medica. The power of distinguishing these various species

from each other must be of consequence to him who has to make use of their products. Medical men are expected to be able to refer each item of the Pharmacopœia, which may be derived from the animal or vegetable kingdom, to the particular species of animal or plant by which it is contributed; to assign every such species to its family and class; and to be acquainted with their constitution and the general characters of the beings included within their bounds. A knowledge of botany enables us to distinguish such plants as are harmless or nutritive in their properties from such as are deleterious or poisonous. This knowledge is not often called for in the ordinary routine of medical practice, but to those who enter either of the services it may become of great consequence. The army or navy surgeon, when in the field or at sea, is not unfrequently thrown upon the resources of his early studies. During the perils of warfare he may find himself in situations when a stray recollection, derived from his former pursuit of the collateral sciences, may put it within his power to afford substantial relief to his suffering comrades. Even the wisdom of the herborist is then of value. When famine or sickness is raging, it is often within the power of the medical naturalist to alleviate its horrors, to select the wholesome herb from among the poisonous, or to find a substitute for medicine among the indigenous plants of the country when the medicine-chest is exhausted or plundered. Every naturalist who has wandered among the wilds of a half-civilized land must recollect times, when any little information he could give on the nutritive or medicinal properties of its productions was gratefully and with avidity received by its poor inhabitants. To feel that we can alleviate distress, or add a comfort, is a pleasure which lasts throughout life, and the recollection of which is as refreshing to the giver as the succour was to the receiver.

Botany then is of importance to the medical man as a means of acquiring a knowledge of the sources of such remedies as are derived from the vegetable kingdom. An important part of the duty of the Professor is to teach the student how he is to gain that knowledge; the exposition of its results rather belongs to the office of the Professor of Materia Medica, and I need not remind you that few combine such an extensive and original knowledge of that branch of medical inquiry, with a profound acquaintance with botanical science, as my eminent colleague in that department.

A knowledge of the facts of botany is of importance also to the agriculturist and the chemist, and even to the man of the world it may afford profit and pleasure. To the first the principles, at least, of physiological botany are necessary if he would rightly understand what he is about. The union between botany and agriculture is every day drawn closer, and in these times, when we find the once distinct characters of the country gentleman and man of science so often and so honourably combined, botanical and chemical science have become essential parts of his education. The researches of the chemist are now more than ever directed to the investigation of organized bodies, and a knowledge of the principles of vegetable physiology is a necessary aid to the success of his inquiries.

The man of the world, whose time is at his own disposal, and whose year is in part devoted to foreign travel, will find a knowledge of botany a new source of pleasure. All who have journeyed much in foreign lands have felt the delight of examining some beautiful and strange flower, when crossing some wide and dreary tract of country, such as every here and there we meet with on the continent; and many an idler has been metamorphosed into a man of science by the recollection of the satisfaction he had derived from such accidental direction of his attention to the minuter beauties of nature, and from

the desire to renew the pleasure he then experienced. As long ago as the days of the first King James, the most chivalrous nobleman in England wrote in his autobiography, "it is a fine study and worthy of a gentleman to be a good botanic*."

The utility of a study of botany to the zoologist and geologist cannot be too highly estimated. The perfection to which the labours of Linnæus, DeJussieu, DeCandolle and their numerous co-labourers and pupils have brought systematic botany, furnishes the zoologist with a sound model on which to mould the descriptive part of his science, but one with which he is usually I fear too slightly acquainted to make good use of. Zoology has yet to attain the precision to which botany so rapidly advanced through the logical acuteness of the great minds who embraced the study,—a precision greatly forwarded by the general knowledge of their subject which they considered it their duty to acquire before they engaged in original special research. The perfection to which botanical diagnosis has attained is truly astonishing. More than 50,000 species of known plants are distinguished from each other by short summaries of their essential characters, sometimes occupying but a few words, and at most but a few lines. Yet there is no confusion. The printed diagnosis is sufficiently precise to enable the student to ascertain the name and affinities of any plant he may gather even without the help of figures or other artificial aid. That zoological science may attain an equal degree of precision, no thinking naturalist can for a moment doubt; but until more zoologists than now do, study the principles by which such precision has been attained, their science must rest in the unsatisfactory state which deforms great portions of it at present.

The importance of a knowledge of botanical science to the

* Lord Herbert.

geologist rests on different grounds. Perhaps to him its greatest value may lie in conferring that training which I have advocated in commenting on the botanical studies of the physician. But it is also of the greatest use in enabling him to understand the nature and relations of the numerous fossil remains of vegetables imbedded in the earth's strata, and the examination of which affords such important data for determining the relative ages of formations, and the conditions under which they were formed. When we recollect that the great beds of coal, which furnish such a valuable item in the list of our economical comforts, have been derived from the destruction of ancient herbs and trees, we must view with astonishment the important part played by the vegetable kingdom in contributing to the substance of the earth's crust.

The history of botany, from the time it first assumed a scientific character to its palmy state in the present century, is more instructive than that of any of the other natural-history sciences, though later in its development; for among the ancients, its most eminent votaries, Theophrastus and Dioscorides, were rather herborists than botanists, and originated no grand generalizations like those which gave the first impulse to zoological science, nursed by the giant mind and indefatigable research of Aristotle. But though zoology started with the speed of the hare, botany, like the slow tortoise, at length overtook it in the race, and the heavy volumes of Bauhin, Gerard and Cæsalpinus were all so many steps on the way. It first quickened its speed as a science of observation. Ardent naturalists went forth into foreign climes, and collected their vegetable products with indefatigable industry, noting carefully their living forms and hues. Others, tied down by the trammels of home-occupation, gathered the plants of their native countries and recorded their variations. Confused ideas of natural affinities clouded their early arrangements,

but from the material so accumulated truer notions were in time generated. The good and kind-hearted rather than the strong-minded were the first votaries of the science. The gentleness of the pursuit was adapted to the kindliness of their natures. Their earnest unbiassed studies originating in the admiration of the wonders and beauties of creation, and deep reverence for the great Origin of all things, were the corner-stones of botanical science, and on such a sound and firm foundation the superstructure could not fail to be nobly and speedily raised. In time the building was commenced; Ray, Tournefort, and a host of lovers of nature laid the first stones. Linnæus and Jussieu were the chosen architects.

The great Swede, whose many-sided mind made all the science of his time contribute to his grand purpose of developing the system of nature, saw at a glance, that though there was much material collected, more must be continually gathering, and that to make good and rapid use of what had been drawn together, machinery was wanting.

"Instrumentis et auxiliis res perficietur: quibus opus est nihilominus ad intellectum quam ad manum*."

Linnæus invented the required instruments and aids. Whilst he taught that the grand aim of botany should be the discovery of the true arrangement of plants in nature, and boldly sketched his idea of what he conceived that arrangement would prove to be,—in order that such great end might be the more speedily attained, he devised two ingenious artificial schemes, which, as he foresaw, led to the desired results. These were the binomial nomenclature, and the classification of plants according to the number or arrangement of their sexual organs.

The first of these inventions, the simplicity of which is that characteristic of all the creations of genius, became the great-

* Bacon, Nov. Org. lib. i. aph. 2.

est means of furthering the progress of natural history. It was endowing it with a universal language, in which all its followers might converse with perfect mutual understanding. The distinctions of nation and tongue were abolished by this admirable scheme, the universal and simultaneous adoption of which at once proclaimed its own excellence and that of its author.

The second was, as it were, the making of an index to a great section of the book of nature. Those who slightingly think of the Linnæan system, as it is termed, forget in the present to look back fully and fairly on the past. They should remind themselves of the state in which botany was when Linnæus undertook to make its treasures consultable. The understanding of things depends greatly on the perception of their order and relations. When that order and those relations require deep study ere we can comprehend them clearly, the man who gives us a clue, however insignificant it may be in its own nature, is not only conferring on us an invaluable benefit, but endowing the despised instrument with golden value. Such a clue did Linnæus give when he put forth the sexual system. The scientific systematist, surrounded by the stores of his herbarium, should not forget that those treasures were often amassed in the first instance by adventurous and earnest men, rendering good service by their hands and energy, as good in its humble way as that which he gives by his head and philosophy. It was not to be expected of such men that in the field they should occupy themselves with thoughts of arrangement or affinity; their part was to observe and select, and the guide to their observation and selection was in most cases no other than the Linnæan system. In the scientific hive as in the apiary there must be working-bees and neuters as well as queens and drones: it is necessary for the economy of the commonwealth. An easy means of acquiring and arranging

information is a great help to the workmen of science, and no department has gained more thereby than botany, which, through the facilities afforded by the artificial method devised by Linnæus, has had its facts amassed in enormous quantity for the use of its more philosophic votaries, and owes its present advanced state in a great measure to such humble means.

The clue to the labyrinth, then, having served such noble purpose becomes a consecrated object, and should rather be hung up in the temple than thrown aside with ignominy. The traveller returning from his adventurous and perilous journey of discovery, hangs up his knapsack with affection on the wall of his study. But travellers must return to the fields, if more is to be done; and so must botanists, and each must have recourse again and again to those helps which aided them so well in their earliest journeys.

In saying these few words in favour of the Linnæan system, I know I am pleading an unpopular cause; but I speak out freely, partly because I mean to proceed on a different basis in conducting the botanical studies here, and partly because, after the once over-enthusiastic attachment to the Linnæan method which prevailed so long in Britain, and which was carried so far as to impede the progress of botany, a reaction has taken place which threatens to blind the eyes of the younger botanists to the merits of a device which was, and ever will be, a most valuable auxiliary of the science.

The aim of Jussieu was of a different kind. Gifted with a highly philosophic mind, he concentrated its powers mainly on one subject. His devotion produced great results. He placed the study of the natural affinities of plants on a practical basis, and originated those views afterwards more fully developed by DeCandolle and other distinguished men. The spirit of Jussieu has presided over the greatest botanical works

down to the present day, and his influence is as powerful now as when he first expounded to his delighted pupils just views of the vegetable kingdom.

The genius and doctrines of Linnæus and Jussieu having placed botany on a sure scientific basis, hosts of labourers crowded to the field, and the enthusiastic pupils and admirers of those great men went forth observing and collecting over every discovered land. The facts they added demanded new research and modified arrangements. Still the great stage of *classification* had been attained, and the science was to enter on the third æra of its existence, that of *philosophical investigation*. In that æra we now live. Its characters are—the observation of facts, not so much for their own sakes as for the illustrations they afford of the laws of the science; careful experimental inquiries into the phænomena of vegetation, not undertaken as isolated researches, but with a view to their comparison with vital phænomena throughout animated nature; minute anatomical investigation under the microscope, not conducted merely to display new forms of structure, but in the hope of solving, if possible, the problem of the ultimate structure of tissues; the construction of local floras and publication of local catalogues, not with the limited view of assisting the inhabitants of a province to a knowledge of their vegetable compatriots, or with the pardonable vanity of showing how many fine plants grow in the author's country, but in order that the great laws of the distribution of organized beings on the surface of our globe may be discovered and developed; and the construction of systematic arrangements, not framed solely for the ascertaining of the natural alliances of families, important as such object is, but also with the view of discovering the great laws which doubtless regulate those alliances equally in the animal and vegetable kingdoms.

Many of the conclusions which such inquiries are yearly

developing, are but the confirmations of hypotheses advanced ere philosophical investigation in botany was the rule and not the exception. But ideas are like seeds: they do not germinate until they meet with the conditions favourable to their germination. The great moving idea of modern botanical philosophy is that of the origin of all the appendages of the vegetable axis in the transformation of the leaf, their normal type. Linnæus himself put it forth in his 'Philosophia Botanica':—

"PRINCIPIUM FLORUM ET FOLIORUM IDEM EST: PRINCIPIUM GEMMARUM ET FOLIORUM IDEM EST: GEMMA CONSTAT FOLIORUM RUDIMENTIS. PERIANTHIUM SIT EX CONNATIS FOLIORUM RUDIMENTIS."*

Thus aphoristically did Linnæus proclaim the grand doctrine of morphology, the influence of which in science, strange to say, was not to be exerted until Goethe, himself a second discoverer of the truth, had proclaimed it anew in a poem. When the prince of naturalists proposed it, the time had not arrived for its appreciation. It lay dormant until the genius of a poet roused it into life and activity.

In like manner, many of the more remarkable botanical theories, propounded within the last few years, have been but the expansions of the original ideas briefly expressed and put forth without parade in the scattered memoirs of that great living botanist, of whom England should be so proud, who has been hailed from afar—the whole botanical world approving—with the well-earned title of "BOTANICORUM FACILE PRINCEPS."

The three phases of botanical science displayed in its history, OBSERVATION, CLASSIFICATION and PHILOSOPHICAL INVESTIGATION, are the types of the stages through which

* Phil. Bot. p. 301. Metamorphosis Vegetabilis.

we must successively pass in the course of our botanical studies. The student must base his science on a correct acquaintance with the forms and structures of plants, and the phænomena of vegetation considered in reference to the vegetable kingdom alone. He must then become familiar with the various families, orders and classes into which the genera and species of plants are grouped; and lastly, having acquired the necessary preliminary knowledge, he is prepared to enter upon the philosophy of the science, the inquiries involved in the subjects of morphology, teretology, anamorphosis and distribution. Yet, though these most interesting departments of botany cannot be fully comprehended until the preliminary knowledge of structure and forms is acquired, the interest they give to the drier inquiries is such, that while the connected theoretical consideration of them must be reserved for the final portions of the Course, I shall make a point, when treating of the facts of physiological and systematic botany, of exhibiting, in all possible cases, the bearings of the latter on the higher departments of botanical science.

In conclusion: whatever the ultimate view of the student respecting the intention of his botanical studies may be,—whether to enter upon them as exercises for the training of those faculties which are afterwards to be applied to professional purposes; or to engage in them with a determination of pursuing botany as a science, and, in the end, developing its laws; or to gain an acquaintance with its facts in order to lay up an intellectual treasure for future hours of recreation or study in a life of business or leisure,—I would remind him earnestly to bear in mind, at the same time, the more serious benefits which may accrue from the study of Botany. That which Lord Bacon said of all knowledge is especially true of this department, that it "is not a couch whereupon to rest a

searching and restless spirit; or a terrace for a wandering and variable mind to walk up and down with a fair prospect; or a tower of state for a proud mind to raise itself upon; or a fort or commanding ground for strife and contention; or a shop for profit or sale;—but a rich storehouse for the glory of the Creator and the relief of man's estate."

THE END.

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